

REMARKS

Reconsideration and further examination of the present application is respectfully requested. The Office Action has rejected claims 1-20. Applicants have amended claims 1 and 8.

35 USC § 103

The Office Action has rejected claims 1-20 under 35 USC § 103(a) as being unpatentable over Grochowski et al., US Patent No. 6,615,366B1 (hereinafter ‘366) further in view of Grochowski et al., US Patent No. 6,625,756 (hereinafter ‘756).

‘366 describes “a processor ... having dual execution cores that may be switched between high reliability and high performance execution modes dynamically, according to the type of code segment to be executed. When the processor is in high performance mode, the dual execution cores operate in lock step on identical instructions, and the execution results generated by each execution core are compared to detect any errors.” (Abstract.)

The Office Action states on page 2 that ‘366 teaches that “the execution mode of the processor as a whole may be tracked through a single processor status bit. The mode can be triggered from HP to HR which is analogous to triggering the FRC recovery routine in the present application.” Applicants respectfully submit that while ‘366 does describe changing from HP to HR (or HR to HP) this is not analogous to triggering FRC reset. HP mode uses both execution cores to process different instructions independently. In the HR mode, “the dual execution cores operate in lock step on identical instructions, and the execution results generated by each execution core are compared to detect any errors.” (‘366, Abstract.) Changing from HP to HR does not trigger a FRC reset but simply shifts the mode of execution from using each core independently to operating in FRC.

‘756 describes “a processor ... that implements a replay mechanism to recover from soft errors. The processor includes a protected execution unit, a check unit to detect errors in results generated by the protected execution unit, and a replay unit to track selected instructions issued to the protected execution unit. When the check unit detects an error, it triggers the replay unit to reissue the selected instructions to the protected execution unit.” (Abstract.) The replay unit of ‘756 may track selected instructions that

are in-flight in a protected execution unit and reissue instructions upon the detection of a soft error. ('756, Col. 3, lines 31-35.) In one embodiment, the replay unit is used to re-execute instructions beginning with the instruction for which the soft error was first detected. ('756, Col. 4, lines 17-19.) This is done to make sure that corrupted data is not used in the re-execution of the instruction. An instruction is tracked until it is retired as once the instruction is retired the processor state is different and may result in corrupt data being re-executed. ('756, Col. 4, lines 5-27.)

With respect to claim 1, Applicants respectfully submit that the combination of '366 and '756 does not describe what Applicants claim requires. Specifically, Applicants submit that the combination of '366 and '756 does not describe: "An apparatus comprising: first and second execution cores to operate in an FRC mode; an FRC check unit to compare results from the first and second execution cores and to store at least one result and a status to indicate if the results match; an error check unit to assert a signal to the FRC checker if a recoverable error is detected in the first or second execution cores; and a timer to trigger an FRC recovery routine if the status indicates the results do not match and the error check unit asserts the signal within a specified interval."

As described in the background of the present application, there is "a race between the logic that processes the corrupted data towards the FRC boundary and the logic that detects its corrupted state. This race can have a significant impact on system availability, due to the longer latency of the reset mechanism triggered by an FRC-error (data mismatch) relative to the recovery mechanism triggered by an underlying parity/ECC error." (Present application, page 3.)

The use of a timer helps with this race. "If the FRC checker detects a mismatch, a potential FRC error is indicated, and a timer is activated to provide the error detector with additional time to identify a recover error from which the FRC error originated. If a recoverable error is detected before the countdown interval expires, a recovery mechanism is triggered." (Present application, page 14.)

While '366 describes changing from HP to HR mode (and vice-versa), this switch from HP to HR is not analogous to the use of a timer to trigger FRC recovery as described above. Also, while '756 describes that "[w]hen the check unit detects an error, it triggers the replay unit to reissue the selected instructions to the protected execution unit", it does not describe the use of a timer to trigger FRC recovery as described above.

Accordingly, the combination of '366 and '756 does not describe what Applicants' claim 1 requires. Claims 2-8 are dependent upon claim 1 and are allowable for at least the same rationale.

With respect to claim 9, Applicants respectfully submit that the combination of '366 and '756 does not describe what Applicants claim requires. Specifically, Applicants submit that the combination of '366 and '756 does not describe: "An system comprising: first and second execution cores to operate in an FRC mode; an FRC checker to compare results from the first and second execution cores and to trigger a countdown interval if the results do not match; and an error detector to monitor error signals during the countdown interval and to disable the FRC checker if a recoverable error is detected before the countdown interval expires."

As explained with respect to claim 1, the combination of '366 and '756 does not describe a countdown interval or an error detector to monitor signals during the countdown interval and to disable the FRC checker if a recoverable error is detected before the countdown interval expires. While '366 describes changing from HP to HR mode (and vice-versa), this switch from HP to HR is not analogous to the use of a countdown interval to disable the FRC checker as described above. Also, while '756 describes that "[w]hen the check unit detects an error, it triggers the replay unit to reissue the selected instructions to the protected execution unit", it does not describe the use of a countdown interval or the disabling of the FRC checker if a recoverable error is detected before the countdown interval expires as described above.

Accordingly, the combination of '366 and '756 does not describe what Applicants' claim 9 requires. Claims 10-16 are dependent upon claim 9 and are allowable for at least the same rationale.

With respect to claim 17, Applicants respectfully submit that the combination of '366 and '756 does not describe what Applicants claim requires. Specifically, Applicants submit that the combination of '366 and '756 does not describe: "A method comprising: comparing results from a first and second execution core to detect an FRC error; if the results do not match, setting a first flag and initiating a countdown interval; monitoring

an error signal for a recoverable error; and initiating a recovery routine if the error signal is asserted before the countdown interval expires.”

As explained with respect to claim 1, the combination of ‘366 and ‘756 does not describe initiating a countdown interval or monitoring for recoverable errors or initiating a recovery routine if a recoverable error is discovered. While ‘366 describes changing from HP to HR mode (and vice-versa), this switch from HP to HR is not analogous to the use of a countdown interval and initiating a recovery routine if a recoverable error is discovered before the countdown interval expires. Also, while ‘756 describes that “[w]hen the check unit detects an error, it triggers the replay unit to reissue the selected instructions to the protected execution unit”, it does not describe the use of a countdown interval.

Accordingly, the combination of ‘366 and ‘756 does not describe what Applicants’ claim 17 requires. Claims 18-20 are dependent upon claim 17 and are allowable for at least the same rationale.

Conclusion

In view of the foregoing remarks and amendments, it is respectfully submitted that the present application is in condition for allowance.

Invitation for a telephone interview

The Examiner is invited to call the undersigned at 408-720-8300 if there remains any issue with allowance of this case.

Charge our Deposit Account

Please charge any shortage to our Deposit Account No. 02-2666.

Respectfully submitted,

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